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PATENT # 4/a
2611-0165P

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant: MATSUMOTO, Wataru
Int'l. Appl. No.: PCT/JP01/02259
Appl. No.: New Group:
Filed: November 30, 2001 Examiner:
For: METHOD OF AND APPARATUS FOR
COMMUNICATION

PRELIMINARY AMENDMENT

BOX PATENT APPLICATION

Assistant Commissioner for Patents
Washington, DC 20231

November 30, 2001

Sir:

The following Preliminary Amendments and Remarks are respectfully submitted in connection with the above-identified application.

AMENDMENTS

IN THE SPECIFICATION:

Please amend the specification as follows:

Before line 1, insert --This application is the national phase under 35 U.S.C. § 371 of PCT International Application No. PCT/JP01/02259 which has an International filing date of March 2, 2001, which designated the United States of America.--

Please replace the paragraphs abridging pages 13 to 15, with the following rewritten paragraph:

--Fig. 1 is an illustration showing configurations of an encoder and a decoder used for a communication apparatus of the present invention; Fig. 2 is an illustration showing a configuration of a transmission system of a communication apparatus of the present invention; Fig. 3 is an illustration showing a configuration of a reception system of a communication apparatus of the present invention; Fig. 4 is an illustration showing signal-point arrangements of various digital modulations; Fig. 5 is an illustration showing a configuration of a turbo encoder 1; Fig. 6 is an illustration showing a recursive-organization convolution encoder constituting the same code as that of the recursive-organization convolution encoder in Fig. 5(b); Fig. 7 is an illustration showing the BER characteristic when decoding transmission data by using a turbo encoder of the present invention and the BER characteristic when decoding transmission data by using a conventional turbo encoder; Fig. 8 is an illustration showing the minimum hamming weight of a turbo encoder of the present invention and the minimum hamming weight of a conventional turbo encoder when using a certain interleaver size; Fig. 9 is an illustration showing the processing by a first embodiment of an interleaver used for a turbo encoder of the present invention; Fig. 10 is an illustration showing the processing by the first embodiment of an interleaver used for a turbo encoder of the present invention; Fig. 11 is an illustration

showing the processing by the first embodiment of an interleaver used for a turbo encoder of the present invention; Fig. 12 is an illustration quantitatively comparing the PPI of the first embodiment with a conventional PIL; Fig. 13 is an illustration showing the processing by a second embodiment of an interleaver used for a turbo encoder of the present invention; Fig. 14 is an illustration showing the processing by the second embodiment of an interleaver used for a turbo encoder of the present invention; Fig. 15 is an illustration showing the processing by the second embodiment of an interleaver used for a turbo encoder of the present invention; Fig. 16 is an illustration quantitatively comparing a PPI of the second embodiment with a conventional PIL; Fig. 17 is an illustration showing inter-signal-point distances of information bit series u_1 and u_2 when assuming the distance between u_1 and u_2 as five rows; Fig. 18 is an illustration showing optimum values of two interleavers when performing rearrangement in accordance with the condition same as the case of the first embodiment; Fig. 19 is an illustration showing a configuration of a conventional turbo encoder used for a transmission system; Fig. 20 is an illustration showing a configuration of a conventional turbo encoder used for a reception system; Fig. 21 is an illustration showing the processing by an interleaver used for a conventional turbo encoder; Fig. 22 is an illustration showing the processing by an interleaver used for a conventional turbo encoder; Fig. 23 is an illustration showing the processing by an interleaver used for a conventional turbo encoder; and Fig. 24 is

an illustration showing a bit error rate characteristic when using a conventional turbo encoder and turbo decoder.--

Please replace the following paragraphs abridging pages 41 and 42, with the following rewritten paragraphs:

--Operations of the interleave of the first embodiment are described below by using the interleaver of the first embodiment.

For example, in the case of this embodiment, rearrangement is performed so that inter-signal-point distances of two information bit series do not become 0. Specifically, information bit series u_1 are arranged in order of first row, second row, third row, ..., and tenth row of an $N \times M$ buffer in the interleaver 32 and information bit series u_2 are arranged in order of fifth row, sixth row, seventh row, ..., and fourth row of the $N \times M$ buffer in the interleaver 33. After rearrangement same as the case of the first embodiment is completed, data series arranged in $N \times M$ buffers in the both interleavers are vertically read in order starting with the first column of the first row.

Fig. 17 is an illustration showing the inter-signal-point distance between the information bit series u_1 and information bit series u_2 when assuming the distance between u_1 and u_2 as five rows. Moreover, in the case of this embodiment, all inter-signal-point distances are obtained not only when assuming the distance between u_1 and u_2 as five rows but also when assuming the distance between u_1 and u_2 as one to nine rows. Then, in the case of this

embodiment, rearrangement is performed by using two interleavers having the distance between u_1 and u_2 from which an optimum transmission characteristic is obtained out of the inter-signal-point distances.

Fig. 18 is an illustration showing optimum values of two interleavers when rearrangement is performed under the same condition as the case of the first embodiment. In this case, an optimum transmission characteristic is obtained when the distance between information bit series u_1 and information bit series u_2 is equal to nine rows.

Thus, in the case of this embodiment, an interleaver from which an optimum transmission characteristic is obtained is selected by obtaining all distances between the information bit series u_1 and information bit series u_2 and moreover obtaining the inter-signal-point distance for each of the distances. Thereby, it is possible to realize an interleaver most suitable for the turbo encoder having two information bit series shown in Fig. 5(a), that is, an interleaver capable of taking a sufficient inter-signal-point distance between information bit series.--

Please replace the following paragraph beginning on page 44, line 5, with the following rewritten paragraph:

--According to still another aspect of the present invention, a rearrangement unit capable of obtaining an optimum transmission characteristic is selected by obtaining all distances between information bit series u_1 and information bit series u_2 and

moreover obtaining the inter-signal distance for each of the distances. Thereby, an advantage is obtained that it is possible to obtain a communication apparatus capable of realizing rearrangement unit most suitable for a turbo encoder having two information bit series, that is, rearrangement unit capable of taking a sufficient inter-signal-point distance between information bit series.--

Please replace the following paragraph abridging pages 45 and 46, with the following rewritten paragraph:

--According to still another aspect of the present invention, for example an interleaver from which an optimum transmission characteristic can be obtained is selected by obtaining all distances between information bit series u_1 and information bit series u_2 and moreover obtaining the inter-signal distance for each of the distances. Thereby, an advantage is obtained that it is possible to obtain a communication method capable of realizing optimum rearrangement for the turbo encoder having two information bit series, that is, rearrangement capable of taking a sufficient inter-signal-point distance between information bit series.--

REMARKS

The specification has been amended to provide a cross-reference to the previously filed International Application.

The specification has also been amended to correct typographical errors made during translation of the International Application.

Entry of the above amendments is earnestly solicited. An early and favorable first action on the merits is earnestly solicited.

Attached hereto is marked-up version of the changes made to the application by this Amendment.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

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By 
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Attachment: VERSION WITH MARKINGS TO SHOW CHANGES MADE

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IN THE SPECIFICATION:

The paragraph abridging pages 13 to 15 has been amended as follows:

Fig. 1 is an illustration showing configurations of an encoder and a decoder used for a communication apparatus of the present invention; Fig. 2 is an illustration showing a configuration of a transmission system of a communication apparatus of the present invention; Fig. 3 is an illustration showing a configuration of a reception system of a communication apparatus of the present invention; Fig. 4 is an illustration showing signal-point arrangements of various digital modulations; Fig. 5 is an illustration showing a configuration of a turbo encoder 1; Fig. 6 is an illustration showing a recursive-organization convolution encoder constituting the same code as that of the recursive-organization convolution encoder in Fig. 5(b); Fig. 7 is an illustration showing the BER characteristic when decoding transmission data by using a turbo encoder of the present invention and the BER characteristic when decoding transmission data by using a conventional turbo encoder; Fig. 8 is an illustration showing the minimum hamming weight of a turbo encoder of the present invention and the minimum hamming weight of a conventional turbo encoder when using a certain interleaver size; Fig. 9 is an illustration showing the processing by a first embodiment of an interleaver used for a turbo encoder of the

present invention; Fig. 10 is an illustration showing the processing by the first embodiment of an interleaver used for a turbo encoder of the present invention; Fig. 11 is an illustration showing the processing by the first embodiment of an interleaver used for a turbo encoder of the present invention; Fig. 12 is an illustration quantitatively comparing the PPI of the first embodiment with a conventional PIL; Fig. 13 is an illustration showing the processing by a second embodiment of an interleaver used for a turbo encoder of the present invention; Fig. 14 is an illustration showing the processing by the second embodiment of an interleaver used for a turbo encoder of the present invention; Fig. 15 is an illustration showing the processing by the second embodiment of an interleaver used for a turbo encoder of the present invention; Fig. 16 is an illustration quantitatively comparing a PPI of the second embodiment with a conventional PIL; Fig. 17 is an illustration showing inter-signal-point distances of information bit series $[U1]u_1$ and $[U2]u_2$ when assuming the distance between $[U1]u_1$ and $[U2]u_2$ as five rows; Fig. 18 is an illustration showing optimum values of two interleavers when performing rearrangement in accordance with the condition same as the case of the first embodiment; Fig. 19 is an illustration showing a configuration of a conventional turbo encoder used for a transmission system; Fig. 20 is an illustration showing a configuration of a conventional turbo encoder used for a reception system; Fig. 21 is an illustration showing the processing by an interleaver used for a conventional turbo encoder; Fig. 22 is an

illustration showing the processing by an interleaver used for a conventional turbo encoder; Fig. 23 is an illustration showing the processing by an interleaver used for a conventional turbo encoder; and Fig. 24 is an illustration showing a bit error rate characteristic when using a conventional turbo encoder and turbo decoder.

The paragraph abridging pages 41 and 42 has been amended as follows:

Operations of the interleave of the first embodiment are described below by using the interleaver of the first embodiment. For example, in the case of this embodiment, rearrangement is performed so that inter-signal-point distances of two information bit series do not become 0. Specifically, information bit series $[U1]u_1$ are arranged in order of first row, second row, third row, ..., and tenth row of an $N \times M$ buffer in the interleaver 32 and information bit series $[U2]u_2$ are arranged in order of fifth row, sixth row, seventh row, ..., and fourth row of the $N \times M$ buffer in the interleaver 33. After rearrangement same as the case of the first embodiment is completed, data series arranged in $N \times M$ buffers in the both interleavers are vertically read in order starting with the first column of the first row.

Fig. 17 is an illustration showing the inter-signal-point distance between the information bit series $[U1]u_1$ and information bit series $[U2]u_2$ when assuming the distance between $[U1]u_1$ and

[U2] \underline{u}_2 as five rows. Moreover, in the case of this embodiment, all inter-signal-point distances are obtained not only when assuming the distance between [U1] \underline{u}_1 and [U2] \underline{u}_2 as five rows but also when assuming the distance between [U1] \underline{u}_1 and [U2] \underline{u}_2 as one to nine rows. Then, in the case of this embodiment, rearrangement is performed by using two interleavers having the distance between [U1] \underline{u}_1 and [U2] \underline{u}_2 from which an optimum transmission characteristic is obtained out of the inter-signal-point distances.

Fig. 18 is an illustration showing optimum values of two interleavers when rearrangement is performed under the same condition as the case of the first embodiment. In this case, an optimum transmission characteristic is obtained when the distance between information bit series [U1] \underline{u}_1 and information bit series [U2] \underline{u}_2 is equal to nine rows.

Thus, in the case of this embodiment, an interleaver from which an optimum transmission characteristic is obtained is selected by obtaining all distances between the information bit series [U1] \underline{u}_1 and information bit series [U2] \underline{u}_2 and moreover obtaining the inter-signal-point distance for each of the distances. Thereby, it is possible to realize an interleaver most suitable for the turbo encoder having two information bit series shown in Fig. 5(a), that is, an interleaver capable of taking a sufficient inter-signal-point distance between information bit series.

The paragraph beginning on page 44, line 5, has been amended as follows:

According to still another aspect of the present invention, a rearrangement unit capable of obtaining an optimum transmission characteristic is selected by obtaining all distances between information bit series $[U1]u_1$ and information bit series $[U2]u_2$ and moreover obtaining the inter-signal distance for each of the distances. Thereby, an advantage is obtained that it is possible to obtain a communication apparatus capable of realizing rearrangement unit most suitable for a turbo encoder having two information bit series, that is, rearrangement unit capable of taking a sufficient inter-signal-point distance between information bit series.

The paragraph abridging pages 45 and 46 has been amended as follows:

According to still another aspect of the present invention, for example an interleaver from which an optimum transmission characteristic can be obtained is selected by obtaining all distances between information bit series $[U1]u_1$ and information bit series $[U2]u_2$ and moreover obtaining the inter-signal distance for each of the distances. Thereby, an advantage is obtained that it is possible to obtain a communication method capable of realizing optimum rearrangement for the turbo encoder having two information bit series, that is, rearrangement capable

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of taking a sufficient inter-signal-point distance between information bit series.

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